



# United States Department of the Interior

NATIONAL PARK SERVICE

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**SUBJECT:**            **White-nose syndrome in bats and risk for bat-human contact**

**TO:** Sarah Craighead  
Superintendent  
Mammoth Cave National Park

## Background

White-nose syndrome (WNS) is a fungal disease affecting hibernating bats, particularly *Myotis* species such as little brown, Indiana, and northern long-eared bats and *Perimyotis* (i.e. tri-colored) bats. Since the disease was first described in New York in 2006, WNS has spread to 25 states and 5 Canadian provinces (as of August 2014) and has killed millions of bats in North America.<sup>1</sup> In Kentucky, WNS was first detected in April 2011 and at Mammoth Cave National Park (MACA) in January 2013.<sup>2,3</sup>

Data from other states suggest that WNS activity peaks 2-3 years after initial detection,<sup>4</sup> which for MACA, is anticipated to occur during the 2014–15 or 2015–16 hibernating seasons. Because WNS can cause affected bats to exhibit unusual behavior during winter/spring months (e.g. flying erratically, clustering at cave entrances),<sup>5</sup> this increases the probability of bat-human contact as well as the potential need for costly rabies post-exposure prophylaxis in humans. Approximately 5% of bats in Kentucky that are captured and tested after having human contact are rabies-positive (J. Poe, personal communication).

In 2014 (when WNS had been detected in most of the major hibernacula at MACA), 11 bat-human contacts were reported among MACA visitors (n=10) and employees (n=1), compared to only 0-1 bat-human contacts reported each year during 2008–13. As 2014 marked the first time MACA asked visitors to report contact with bats, it is unclear how many of the 11 contacts were attributable to WNS vs. enhanced reporting; however, the fact that all bat-human contacts occurred in the winter/spring suggests WNS as a primary cause for bat behavioral changes. In either case, park managers remain concerned that the number of bat-human contacts might increase in 2015, and alternate park and cave tour operational plans are being considered.

On December 10, 2014, MACA Superintendent Sarah Craighead requested on-site assistance from the National Park Service (NPS) Disease Outbreak Investigation Team (DOIT)—a multi-

disciplinary unit including subject matter experts in public health, wildlife health, and environmental health—to address the following tasks:

- Conduct a *risk assessment* for potential human-bat encounters in various park settings (e.g. cave tours, hiking trails, employee lodging, high-use visitor areas)
- Identify new and enhance existing *prevention and response activities* to minimize the risk of human-bat encounters
- Define circumstances (i.e. *triggers*) that indicate the need for specific prevention and response actions to be taken
- Develop *communication and educational materials* for park employees, visitors, and external stakeholders

This report summarizes findings and recommendations for only the first 3 tasks. The DOIT team will continue to work with MACA to develop and review educational/communications materials as needed.

## Methods

The site visit was conducted during December 15-19, 2014 and included the following core DOIT team members: David Wong (Medical Epidemiologist and Team Lead), Cara Cherry (Veterinary Epidemiologist and Co-Lead), Kevin Castle (Wildlife Veterinarian), Tim Pinion (Wildlife Biologist), Adam Kramer (Environmental Health Officer), and Jessica Sharpe (Public Health Consultant who participated remotely).

Other supporting members included John Poe (State Public Health Veterinarian at Kentucky Department for Public Health), Keith Alford (Environmental Specialist at Barren River District Health Department), Monique Kramer (NPS Environmental Health Officer), and Jenny Beeler (Resource Management Chief at Cumberland Gap National Historical Park).

The team was led on walk-throughs of popular cave tours (i.e. Historic Tour and Domes & Dripstones Tour) by Rick Toomey, the research coordinator and WNS lead at MACA. Areas where bats commonly roost and locations of bat-human encounters in 2014 were highlighted. The team also observed other at-risk areas for bat-human activity (e.g. Dixon Cave) and cave entrances used for less popular tours (e.g. Carmichael Entrance).

Background data, maps, and reports on prior WNS activity were compiled by Rick Toomey and reviewed by the team. Meetings were conducted (small- and large-group settings) with Superintendent Craighead, Resource Management staff (Rick Toomey, Chris Clark, and Laura Shultz), the Cumberland-Piedmont Inventory & Monitoring Network mammalogist (Steve Thomas), and other park management staff.

## Results

***Risk Assessment:*** Assuming that WNS is the primary driver for bat-human contacts, the main factors that contribute to risk are (in no particular order): the number of *Myotis* and *Perimyotis* bats, the likelihood of WNS and/or rabies infections in bats that might cause erratic behavior, the number of humans, and the setting for potential bat-human encounters [e.g. enclosed space (i.e. cave) vs. open space (i.e. surface)]. Given these factors, 3 locations were identified as priority areas for prevention and response activities: the Historic Tour route, the Domes & Dripstones Tour route, and Dixon Cave (Table). These 3 areas all experience heavy visitor traffic.

Although bat-human encounters can theoretically occur anywhere in the park (e.g. hiking trails, employee housing), we consider these other areas to be lower—but not zero—risk, compared to potential contacts occurring in or near caves. Bat-human contact data from 2014 (data not shown) demonstrate that 9 of 11 (82%) exposures occurred in caves. Of the 2 surface exposures, 1 occurred in a cave tour participant just outside the Frozen Niagara entrance, and the other exposure occurred when a visitor picked up an injured bat (body only) from a trail using bare hands, a low-risk exposure for which rabies post-exposure prophylaxis was not recommended. From a capacity standpoint, it is also not feasible for the park to sustain intense prevention and response activities at all times in all areas of the park. General messaging about viewing wildlife from a safe distance and reporting any contact with wildlife should be accessible to all park employees, partners, and visitors, including those not participating in cave tours.

Overall, the risk of a visitor at MACA having contact with a bat is extremely low. In 2014, 10 of 522,265 total visitors (approximately 1 of every 50,000 visitors) reported contact with a bat. Among the subset of visitors who participated in cave tours, the risk of bat contact was still extremely low—approximately 1 bat contact per 40,000 cave visitors.

***Prevention and Response Activities:*** As the world’s longest known cave system and home to 13 bat species (2 endangered and 1 proposed for listing as endangered), MACA is a leader within NPS with regards to WNS preparedness and education. WNS activities previously implemented at MACA include a WNS interpretive display and visitor screening in the Visitor Center (2009), bioremediation mats that visitors are required to walk over after every tour (2011), development of a park-specific WNS response plan (2011), and participation in various WNS research projects (ongoing). In 2014, MACA posted signage advising visitors to view wildlife from a distance and to notify an employee if contact with bats or other wildlife occurred.

Additional prevention and response measures are likely needed in 2015 in preparation for potential increases in bat-human encounters. Broadly, these measures can be categorized as surveillance, education/communication, and tour modifications. Depending on the current situation or risk, these measures are scalable and adaptable. Many of these measures had already been discussed and/or implemented by MACA prior to the DOIT site visit.

- ***Surveillance:*** As a pro-active measure, MACA has hired 2 interns to conduct daily “cave checks” during January–April 2015, the high-risk period for when hibernating bats infected with WNS might exhibit unusual behavior. These cave checks will be conducted systematically by trained individuals at approximately the same time each day. Observations will be made at pre-determined locations, and specific data (e.g. number of flying bats, number of dead bats on the trail, etc.) will be recorded in a spreadsheet and analyzed for trends and patterns. Observations that exceed thresholds (based on the previous 7-day average) will be flagged for further review and/or response. This type of surveillance is termed systematic surveillance, and is the gold standard for data quality.

In addition, opportunistic surveillance will be conducted by other MACA employees (primarily interpretation and environmental education staff who lead frequent tours in or near the priority cave systems) during the course of their daily work. When these employees observe unusual bat activity (e.g. flying or dead bats), the observations will be noted, reported to their shift supervisors, and then sent to resource management staff for recording in a master database. Although these data are not collected systematically, they still can be a

useful and timely alert for unusual bat behavior, particularly since systematic surveillance is labor-intensive and cannot realistically be conducted more than twice per day. Other MACA employees who observe unusual bat activity parkwide are also encouraged to report findings.

It is worth noting that no previous studies have correlated specific measures (e.g. number of flying or dead bats) with the risk for bat-human contact. The data MACA collects in 2015 will help to establish these relationships and determine which measures, if any, are useful indicators for potential bat-human contact.

- *Education/Communication:* Raising awareness of potential health risks is a cornerstone of public health prevention. Individuals who are educated on risks can make informed decisions regarding participation, the use of personal protective measures, and appropriate follow-up should an exposure occur or symptoms develop.

Prior to 2014, MACA education on WNS focused almost entirely on the devastating impacts of WNS on bats. Visitors were and continue to be educated on the signs of the disease in bats, which species are primarily affected, and what they can do (i.e. stepping on bioremediation mats) to reduce further spread of the disease to other caves.

If the number of bat-human contacts increases in 2015, incorporating more direct and specific human health messaging should be considered. The messaging could include information about the risks for bat-human contact, how those risks can be mitigated, and the importance of consulting with a healthcare provider regarding the potential need for rabies post-exposure prophylaxis. This messaging would need to be balanced with the numerous safety messages already discussed by tour guides about appropriate physical fitness levels, slips and falls, claustrophobia, etc. If implemented, this messaging is scalable and could include simple signage in the visitor center, inclusion in a press release or media article, and/or an alert on the park website. The bat-human contact prevention message could be provided as a stand-alone message without mention of WNS and could be crafted to minimize undue alarm or negative perceptions of bats among visitors.

For employees, in addition to park-wide education about WNS and rabies, the park has developed bat response kits that can be used by any employee (preferably, those who have received rabies pre-exposure prophylaxis) to respond to dead or moribund bats in visitor-use areas. These kits have been provided to each division in the park and at strategic locations in visitor-use areas and within the toured areas of caves. Employees and key partners with the park (e.g. Forever Resorts and Eastern National staff) have been trained on how to use these kits to remove bats that could pose a risk to visitors and employees.

- *Tour Modifications:* Alterations to tours can reduce risk of bat-human contact by minimizing the number of bats that are in close proximity to humans. Simple interventions include installing physical barriers (e.g. bat netting or beaded curtains) in artificial cave entrances or narrow cave sections that might restrict bat movement. Other more difficult and higher-impact interventions include reducing tour sizes, moving tours to alternate locations, and canceling tours during specific times of day (if surveillance data suggest that bat activity is high during these time periods); these interventions may or may not be practical, depending on tour volume and logistics. It is important to note that it is unknown if any of these tour modifications or interventions will actually decrease the risk for bat-human contact. As a

final resort, cave tours could be canceled altogether, although compelling data would likely be needed before such a decision is made.

**Triggers:** There are many contextual factors (e.g. time of day, time of year, temperature, species of bat) that should be considered when determining if a certain number of bats, flying bats, or dead bats warrant triggering an intervention. Given this inherent complexity, we developed a general flowchart (see Figure) that uses the previous 7-day average for any given variable as the threshold for triggering—not an intervention—but further investigation and validation of the data by a bat biologist. If the biologist believes that the data indicate increased risk for bat-human contact, then specific interventions can be discussed and acted upon by the park leadership team. When 7-day averages have returned to pre-action levels, cessation of interventions can be considered after appropriate review.

Because the impact of WNS on bat behavior is dynamic and unpredictable, this flowchart is purposefully general and non-specific in order to allow appropriate latitude for decision making. This flowchart can also be modified for each specific site/cave system. If the situation changes dramatically, it may be necessary to abandon this flowchart entirely and consider other decision-making tools and interventions.

### **Key Findings and Recommendations**

1. WNS activity will likely increase at MACA in 2015 and may be associated with increases in bat-human contact.
2. Surveillance data—both systematic and opportunistic—are important to collect and will help inform decision making as well as demonstrate pro-active efforts the park is taking to learn about potential health risks.
3. Given the complex and dynamic nature of bat behavior, the development of rigid “triggers” leading to specific interventions is not recommended; instead, we recommend an open approach where specific data trigger further investigation and discussion by park managers.
4. Decisions regarding management actions, which may be needed in response to changing levels of risk in conjunction with other key park management variables, should be made as circumstances evolve and with continuing expert advice and support.
5. Primary interventions to consider for reducing the risk of bat-human contact include increased surveillance, education/communication, and tour modifications. These interventions are all scalable and adaptable, depending on the current situation.
6. The DOIT team will continue to consult with MACA, the Kentucky Department for Public Health, and the Barren River District Health Department when responding to bat-human contact incidents.
7. Ongoing support will be provided to MACA as decisions are made regarding specific interventions to prevent or mitigate the risk for bat-human contact.

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DOIT Team Leads

## Acknowledgments

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## References

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**Table: Characteristics of Priority Cave Systems and Concerns for Potential Bat-Human Contact**

	<b>Historic Tour</b> (starts and ends at Historic Entrance)	<b>Domes &amp; Dripstones Tour</b> (starts at New Entrance; ends at Frozen Niagara Entrance)	<b>Dixon Cave</b>
<b>Distance from Visitor Center*</b>	0.1 miles	3.2 miles (New) 3.5 miles (Frozen Niagara)	0.3 miles
<b>Open to Public</b>	Yes	Yes	No
<b>Length</b>	2 Miles	$\frac{3}{4}$ Mile	N/A
<b>Tours/groups that pass through or near</b>	Historic  Smaller tours that use Historic Entrance: -Lantern -River Styx -Mammoth Passage -Discovery -Gothic -Star Chamber	Domes & Dripstones (D&D)  Smaller tours that use New or Frozen Niagara Entrances: -Grand Avenue -Frozen Niagara -Wild Cave -Intro to Caving -Focus on Formations	Environmental education school groups plus general visitors (use trail adjacent to Dixon Cave entrance)
<b>No. of tours/groups in Fiscal Year 2014</b>	Historic: 1942 Other tours: 1366	D&D: 2119 Other tours: 1248	125
<b>No. of visitors in Fiscal Year 2014</b>	Historic: 156,507 Other tours: 57,233	D&D: 133,794 Other tours: 34,908	~6500
<b>No. of bat species</b>	Up to 10 use entrance in summer; ~6 in winter	~5 sighted in this area	Up to 10 use entrance at various times during year
<b>Bat population (est.)</b>	100-200	10-20	3200 in winter 100s in summer
<b>No. of <i>Myotis</i> and <i>Perimyotis</i> species</b>	6	4	6
<b><i>Myotis</i>/<i>Perimyotis</i> population (est.)</b>	100-200	10-20	3100 in winter 100s in summer
<b>WNS first detected</b>	2014	2015	2013
<b>No. of bat-human contacts in 2014</b>	3	5	0
<b>Reason(s) for concern for bat-human contact</b>	-Most popular cave tour -Historic is a large natural entrance that cannot be protected with netting, etc. -Known bat swarming site	-2 <sup>nd</sup> most popular cave tour -Many narrow passageways on D&D tour -Area with highest number of bat-human contacts in 2014	-Hibernation site for 2 endangered <i>Myotis</i> species (Indiana and gray) -Proximity to high-visitation areas (e.g. Visitor Center, picnic area, Historic Entrance) -Known bat swarming site -Affected bats may move to Historic Entrance

\*For park maps, see <http://www.nps.gov/macaplanyourvisit/maps.htm>

**Figure. Sample flowchart for how bat surveillance data can be used to inform park management decisions**

